

COMPETING FOR FOREIGN DIRECT INVESTMENTS: A REAL OPTIONS APPROACH

PAOLO M. PANTEGHINI
GUTTORM SCHJELDERUP

CESIFO WORKING PAPER NO. 929
CATEGORY 1: PUBLIC FINANCE
APRIL 2003

An electronic version of the paper may be downloaded

- *from the SSRN website:* www.SSRN.com
- *from the CESifo website:* www.CESifo.de

COMPETING FOR FOREIGN DIRECT INVESTMENTS: A REAL OPTIONS APPROACH

Abstract

This paper uses the Bad News Principle to study how the ability of multinationals to shift profits by transfer pricing affects both the timing of foreign direct investment decisions and government tax policy. A main finding of the paper is that if countries compete to attract foreign direct investments, only weak conditions are needed to establish that welfare is higher when firms can postpone irreversible investments as opposed to when they cannot.

JEL Code: H25.

Keywords: corporate taxation, irreversibility, MNE, real options and uncertainty.

*Paolo M. Panteghini
University of Brescia
Department of Economics
Via San Faustino 74/B
25122 Brescia
Italy
panteghi@eco.unibs.it*

*Guttorm Schjelderup
Norwegian School of Economics and Business
Administration
Economics Department R 307
Helleveien 30
5045 Bergen
Norway
guttorm.schjelderup@nhh.no*

The authors are grateful to Carlo Scarpa and Hans Jarle Kind for helpful comments and suggestions. The usual disclaimer applies.

1 Introduction

The tax competition literature studies how capital taxes are set by independent governments that do not cooperate. At the heart of this literature are underlying assumptions concerning the role of capital. Most studies are either done under the assumption that capital investment is fully reversible or, alternatively, that capital investment is irreversible but characterised by exogenous investment timing.¹ As argued by Dixit and Pindyck (1994, p.3), however; “*Most investment decisions share three important characteristics; investment irreversibility, uncertainty, and the ability to choose the optimal timing of investment*”.

In this paper we argue that the description above by Dixit and Pindyck is especially relevant for foreign direct investments (FDIs). FDIs usually entail the payment of sunk costs making them at least partially irreversible. Moreover, imperfect information concerning market conditions and national rules and regulations means that there is uncertainty related to the true costs of FDIs and their payoff. Finally managers are aware that investments present opportunities and are not an obligation and that irreversible choices reduce the flexibility of their strategy. Thus, managers behave as if they owned option-rights thereby computing the optimal investment (exercise) timing. In slight abuse of language, we will in what follows sometimes refer to the situation when managers have the option to delay their FDIs as the now-or-later case, whilst the situation where managers cannot time their decisions is labelled the now-or-never case.

Using a real-option approach, the focal point of the analysis is two-fold; (i) we analyze how the ability to postpone FDI decisions affects firm behavior under taxation, and (ii) how taxes in the Nash equilibrium are set when governments compete to attract foreign direct investments. In the standard tax competition literature the issue of timing is ignored, and a main question is therefore how the ability to delay investments affects taxes and welfare in the tax equilibrium.² Our model embeds two empirical facts pertaining to multinationals.³ First, multinational firms can shift

¹Surveys of this literature are given in Wilson (1999) and Wildasin and Wilson (2001).

²See e.g., Zodrow and Mieszkowski (1986) and Wilson (1986) for benchmark results in the standard tax competition literature.

³It is well known in the tax competition literature that multinationals shift profits by way of transfer prices, and the role of statutory tax rates is documented in Hines (1999). For surveys on transfer pricing and multinationals see Hines (1999) and Gresik (2001).

profits to low-tax countries by transfer pricing and, second, the amount of profits shifted is a function of statutory tax rates.

The findings in this paper can be divided into two categories; those that pertain to firm behavior, and those that affect tax policy by governments. On the firm level we apply Bernanke's (1983) Bad News Principle (BNP) and show that taxation affects investment timing. Furthermore, the ability of multinationals to shift profits has an asymmetric effect on when FDIs are profitable (henceforth referred to as threshold investment values). Profit shifting reduces the threshold values more in the now-or-later case than in the now-or-never case. The second set of results pertains to the outcome of tax competition. If the average profitability of firms in the economy is sufficiently high, tax competition to attract FDI leads to higher tax rates, higher tax revenue, and a rise in welfare when firms can time their investments as opposed to when they cannot.

The structure of the article is as follows. Section 2 outlines the basic principles used in the analysis pertaining to the timing of investments. Section 3 models the investment strategy of a firm considering whether or not to undertake FDIs. Section 4 uses a two-country model to investigate how taxes are affected by competition between countries over FDI. Finally, section 5 concludes.

2 Some Preliminaries

In this section we introduce a two-period model describing investment choices by a multinational. For simplicity we employ a model with two symmetric countries called A and B . Let $PDV_{0,A}$ be the net present value of additional profits (i.e., profits above those derived from home investments) produced by a firm with its headquarters (HQ) in country A at time 0. Without any opportunity to delay irreversible investment, the firm decides whether to undertake an investment according to the standard net-present-value rule

$$\max \{PDV_{0,A}, 0\}. \quad (1)$$

As commonly argued in the literature on investment decisions (see e.g. Trigeorgis, 1996), managers are well aware that any decision to undertake irreversible investment reduces the flexibility of their strategy. Investment opportunities, therefore,

are not obligations, but option-rights. If firms can postpone irreversible investments, they will choose the optimal exercise timing, and the rule given in (1) changes. One must now take into account the option to delay. To see the implication, suppose the firm can delay investment until time 1. If the firm invests immediately, it will enjoy the profit stream between time 0 and time 1. If it waits until time 1, it has the possibility of acquiring new information, which may emerge in the form of good news (profits) or bad news (losses). Therefore, investing at time 0 implies the exercise of the option to delay and entails paying an opportunity cost for the flexibility lost in the firm's strategy.⁴ To decide when to invest, the firm compares $PDV_{0,A}$ with the expected net present value of the investment opportunity at time 1, $PDV_{1,A}$. The optimal decision entails choosing the maximum value:

$$\max \{PDV_{0,A}, PDV_{1,A}\}. \quad (2)$$

Subtracting (1) from (2) yields the option to delay as $\max \{PDV_{1,A}, 0\}$. Equation (2) shows that the firm chooses the optimal investment timing by comparing the two alternative policies. If the inequality $PDV_{0,A} > PDV_{1,A}$ holds, immediate investment is undertaken. If instead, $PDV_{1,A} > PDV_{0,A}$, then waiting until time 1 is better. This rule can be interpreted as follows: if the firm receives good news (positive profits), it invests. If, instead, it faces losses, it does not invest.

As shown by Bernanke (1983) if the firm can postpone its investments, the investment decision depends on bad news, but is independent of the good news. This result is often referred to as the *Bad News Principle (BNP)*, and states that uncertainty acts asymmetrically, since only unfavorable events affect the current propensity to invest. The implication of the BNP is that the worse the news, the higher is the return required to compensate for irreversibility. Consequently, the higher is the trigger point for when investment is profitable.

The rules outlined above differ slightly if we introduce taxation. Define $T_{0,A}$ as the present discounted value of tax payments when investment is undertaken at time 0 by a firm located in country A . In the absence of any option to delay, the firm's problem is

$$\max \{NPV_{0,A}, 0\}, \quad (3)$$

⁴McDonald and Siegel (1986) show that the opportunity to invest is analogous to a call option.

where $NPV_{0,A} \equiv PDV_{0,A} - T_{0,A}$. If $NPV_{0,A} > 0$, investing abroad is profitable and vice versa. Equation (3) describes an investment rule that is used by the empirical tax competition literature to study the effects of average taxation on investment (e.g., Devereux and Griffith, 1998). It shows that when the firm can postpone investment, average taxation matters for investment (and location) decisions.

If the firm can delay investments and $T_{1,A}$ is the present value of tax payments when investment is undertaken at time 1, the firm's maximization problem becomes

$$\max \{NPV_{0,A}, NPV_{1,A}\}, \quad (4)$$

where $NPV_{1,A} \equiv PDV_{1,A} - T_{1,A}$. It is worth noting that delaying investment entails a postponement in the tax payment. In particular, an increase in $(T_{0,A} - T_{1,A})$ raises the tax savings due to the delay of investment. This discourages immediate investment.⁵ In the following sections we use rules (3) and (4) to study FDI decisions as well as the outcome of tax competition over FDI.

3 The model

We consider a representative firm that initially is located only in country A . The firm earns a certain net profit flow after tax equal to $(1 - \tau_A)\pi_A$, where τ_A is the statutory tax rate and π_A is gross profits. The firm has an opportunity to expand production by investing in country B . For simplicity we assume that expanding production in the home country is less profitable than producing abroad.⁶

Define I as the sunk investment cost which must be paid by the firm to enter the foreign market. Let $(1 + j)\pi_B$ be gross profits in country B . At time 0, j is zero. At time 1, however, it will change: with probability q , it will be $j = u$ and with probability $(1 - q)$ it will be negative $j = -d$. Parameters u and d are positive and measure the downward and upward profit moves, respectively. At time 1, uncertainty vanishes due to the release of new information and gross profits will remain at the new level forever. Risk is fully diversifiable and both countries are assumed to be

⁵For further details on the effects of taxation on investment timing, see Panteghini (2002).

⁶There may be several reasons for not expanding abroad. Lack of OLI advantages in the sense of Dunning (1977) may be one. Others may pertain to home anti-trust legislation, or simply that there are technological reasons (diseconomies of scale) in the home country, which may make FDI more profitable.

small so that the interest rate r used to discount profits is fixed. Furthermore, we assume that:

Assumption 1. *The shock is mean-preserving*

$$q(1 + u) + (1 - q)(1 - d) = 1.$$

According to the above assumption, any change in one of the relevant parameters is offset by changes in the other parameters. The implication is that the expected current payoff is equal to the payoff faced by the firm at time 0. As will be shown later in this section, despite Assumption 1, the BNP will make bad news relevant for investment decisions when the firm has an option to delay.

Foreign profits are taxed at the rate τ_B . After investing abroad, the firm can save tax payments in the high tax country by shifting profits to the low tax country. We denote the amount of profits shifted by $\beta \leq 0$. In line with most of the literature on transfer pricing we make the realistic assumption that it is costly to conceal deviations in the transfer price from the true cost of production. Hence, profit shifting entails convex costs, $\nu(\beta)$, with $\nu(0) = \nu'(0) = 0$ and $\nu''(\beta) > 0$. The cost element may be interpreted as the hiring of lawyers or consultants to conceal the illegality of the transaction.⁷

The overall net operating profits of the firm (if it invests in B) are

$$\Pi_A^N(j) = (1 - \tau_A)\pi_A + (1 - \tau_B)(1 + j)\pi_B + \phi(\beta)\pi_A, \quad (5)$$

where $\phi(\beta) \equiv [(\tau_A - \tau_B)\beta - \nu(\beta)]$ measures the net per-unit tax savings arising from profit shifting. With no consequence for our results, we normalize overall tax savings with respect to π_A .⁸ In what follows we make the reasonable assumption that it is costly to shift all profits in the sense that the multinational firm cannot eliminate positive profits in the high-tax country. The implication of this assumption is that

$$[(1 - \tau_A) - \beta]\pi_A > 0, \quad (1 - \tau_B)(1 + j)\pi_B + \beta\pi_A > 0, \quad \Pi_A^N(j) > 0,$$

which holds for a sufficiently convex cost function $\nu(\beta)$.

⁷These costs may be tax deductible or they may not. Neither assumption has an impact on the qualitative results, but tax deductibility lowers the cost of profit shifting. See Haufler and Schjelderup (2000) for a more detailed discussion.

⁸The normalization does not affect our results.

Differentiating (5) with respect to the transfer pricing variable β , one obtains the optimal level of profit shifting

$$\beta_A^* = \beta \mid \nu'(\beta) = \tau_A - \tau_B \quad (6)$$

Equation (6) states that the firm shifts profits to the low tax country so that if $\tau_A < \tau_B$ ($\tau_A > \tau_B$), then $\beta > 0$ ($\beta < 0$). This result is in line with empirical findings suggesting that statutory tax rates matter for the transfer pricing decision.⁹

Substituting the result of (6) yields

$$\Pi_A^N(j, \beta_A^*) \equiv \max_{\beta} \Pi_A^N(j).$$

In what follows we start out by asking what level of profit is needed for foreign investments to occur when the firm cannot delay its investments. We then compare this benchmark level to the profit level necessary to trigger investment when the firm can postpone its investment.

FDI without the option to delay investments. If the multinational firm cannot postpone its investment abroad, its problem is defined by (3). For the firm to invest abroad, the profits derived from doing so must exceed those obtained if it only invests at home. In order to establish the level of investments (trigger point) that makes FDI profitable, we solve $NPV_{0,A} = 0$ for π_B ,

$$\pi_B^* = \frac{r}{1+r} \frac{\tilde{I}}{1-\tau_B}, \quad (7)$$

where $\tilde{I} \equiv [(1-\tau_B)I - \frac{1+r}{r}\phi(\beta_A^*)\pi_A]$ is the effective net sunk cost.

It is seen from (7) that a requirement for FDI to be undertaken is that $\pi_B > \pi_B^*$, since otherwise the firm is better off refraining from investing abroad. It is worth noting that π_B^* is affected by *both* good and bad news. Given Assumption 1, however, the net effect of news (bad or good) is zero.

The effect of profits shifting on FDI is also evident from (7); the more profitable it is to shift profits (a high $\phi(\beta_A^*)$), the lower is \tilde{I} and the trigger point that induces

⁹See Hines (1999) for empirical results concerning transfer pricing. Note that β_A^* is not state-contingent due to our assumptions about the convexity of the cost function $v(\beta)$. If we relaxed this assumption so that one of the profit expressions could be zero, a corner solution would be obtained, and β_A^* would be state contingent.

FDI. Put differently, profit shifting allows the firm to save tax payments and makes investments even in high-tax countries more attractive.

FDI with the option to delay investments. Suppose now that the firm can postpone its foreign investment. In order to undertake this analysis we need to specify how one should interpret bad news. We make the following assumption:

Assumption 2: *If at time 1 the firm faces bad news, the present discounted value of future profits is less than the net discounted cost of investment, that is:*

$$\sum_{t=1}^{\infty} \frac{\Pi^N(-d, \beta_A^*)}{(1+r)^t} - \frac{1-\tau_B}{1+r} I < 0. \quad (8)$$

Assumption 2 states that bad news inflicts a loss on the firm. If this were not the case, all news would be good in the sense that any news would generate positive profits and the BNP would not apply. It follows from (8) that a rational firm does not invest at time 1 under the bad state. In order to find the trigger value above which immediate FDI is profitable when the firm can delay its investments, we set $NPV_{0,A} - NPV_{1,A} = 0$, and solve for π_B . This yields (the full derivation is given in the Appendix)

$$\pi_B^{**} = \eta \pi_B^*, \quad (9)$$

where $\eta \equiv \frac{r+(1-q)}{r+(1-q)(1-d)}$ is the wedge between the two threshold values. Since the trigger point for investment abroad π_B^{**} must account not only for the explicit investment costs (net of the tax benefit of profit shifting), but also for the opportunity cost, which is represented by the exercise of the call option, it must be the case that $\eta > 1$. Thus, equation (9) shows that the firm requires higher expected profits to undertake FDI in the now-or-later case than in the now-or-never case (i.e., $\pi_B^{**} > \pi_B^*$) due to the option of postponing its investment. Put differently, uncertainty has an asymmetric effect on firm profits in the now-or-later case. In particular, the investment decision depends on the seriousness of the downward move, d , and its probability $(1-q)$, but is independent of the parameter that leads to the upward move. This can be explained by Bernanke's (1983) BNP. If the firm that owns an option to delay invests either at time 0 or at time 1 and receives good news, the investment is profitable irrespective of the firm's timing. In contrast, timing is crucial if bad news is reported. To see this, say the firm waits until time 1 with its investment and then

receives bad news. In this case it will not invest and the choice of waiting turns out to be a good choice. If, instead, it had invested at time 0, it would have regretted its choice. Thus, bad news matters for the timing of investments, but good news does not.¹⁰

In order to obtain more information about the firm's investment decisions under the two alternative scenarios, we use (7) and (9), to derive

$$\Delta \equiv \pi_B^{**} - \pi_B^* = \frac{d(1-q)}{r + (1-q)(1-d)} \pi_B^* = (\eta - 1) \tilde{I} > 0, \quad (10)$$

The impact of profit shifting on the relative threshold values for investments is evident from (10) through \tilde{I} . The greater the net tax savings from profit shifting and transfer pricing (i.e., a high $\phi(\beta_A^*)$), the lower is \tilde{I} , and the smaller is the difference between the two trigger points. Thus, profit shifting affects threshold values asymmetrically and reduces the trigger point more in the now-or-later case than in the now-or-never case. It can be shown that this asymmetry also extends to how the BNP works, in the sense that bad news has a greater impact on the threshold value for investments in the now-or-later case than in the now-or-never case. In particular:

Proposition 1 *As bad news gets worse, the greater is the difference $\Delta = \pi_B^{**} - \pi_B^* > 0$.*

Proof. It is straightforward to show that $\partial\Delta/\partial x > 0$ and $\partial\pi_B^*/\partial x = 0$ with $x = 1 - q, d$.

$$\frac{\partial\Delta}{\partial(1-q)} = \frac{\partial\pi_B^{**}}{\partial(1-q)} = \frac{rd}{[r + (1-q)(1-d)]^2} > 0$$

$$\frac{\partial\Delta}{\partial d} = \frac{\partial\pi_B^{**}}{\partial d} = \frac{(1-q)[r + (1-q)]}{[r + (1-q)(1-d)]^2} > 0$$

where the positive sign follows immediately from the definition of the variables r, d and q . ■

¹⁰As stated by Bernanke (1983) "the impact of downside uncertainty on investment has nothing to do with preferences ... The negative effect of uncertainty is instead closely related to the search theory result that a greater dispersion of outcomes, by increasing the value of information, lengthens the optimal search time" [p. 93].

Proposition 1 shows that bad news increases the effective sunk cost (\tilde{I}) and thus widens the difference Δ . In both the now-or-never case and the now-or-later case, the higher \tilde{I} is, the higher is the profit threshold for acceptance of the investment project. In the now-or-later case, however, this effect is greater in magnitude. When firms own an option to delay, an increase in \tilde{I} raises the opportunity cost (i.e. the option value).

Our discussion so far has aimed at contrasting investment decisions when the firm cannot delay investments to the case when investments can be postponed in a tax environment with profit shifting. The setup captures the main features of how multinationals act as well as the tax implications. In the next section we analyze the impact on tax rates if countries compete to attract investments from firms.

4 FDI in a tax competitive setting

In this section we investigate how the option to delay investments affects tax rates in a setting with two identical countries, A and B . The governments' objective functions are given by the expected present value of tax revenues. Both countries set their tax rate at the beginning of the first period, so as to maximize their own revenues, taking the other country's tax rate as given. We assume that each government can precommit to these tax rates.¹¹ We define π_i^* and π_i^{**} as the trigger points (now-or-never and now-or-later cases) of a firm located in country j that considers to invest in country i , where $i \neq j$. Let $\phi(\beta_i^*) \equiv [(\tau_i - \tau_j)\beta_i^* - \nu(\beta_i^*)]$ be the optimal percentage of tax savings from profit shifting where tax savings are normalized with respect to π .

We assume that the economy consists of a continuum of firms, each with its own starting profit (π) arising from investing abroad. The firm-specific profits are distributed according to a linear density function $f(\pi)$ with $\pi \in [\underline{\pi}, \bar{\pi}]$. This implies that $F(\pi) = \frac{\pi - \underline{\pi}}{\bar{\pi} - \underline{\pi}}$. We also assume that $\underline{\pi} < \pi_i^*$ $i = A, B$ and that $\underline{\pi} < \frac{r}{1+r}I < (1+u)\underline{\pi}$ hold. These inequalities imply that without taxation, investing abroad is profitable in the good state. The assumption serves to rule out firms that have a zero probability of investing abroad. Finally, we make the assumption that $\bar{\pi} > \pi_i^{**}$.

¹¹Since the tax on capital interacts with the taxation of personal income as well as with other parts of the tax system, one can argue that there are serious costs related to reoptimizing the capital tax. Hence, the assumption of commitment is reasonable.

This means that some firms invest at time 0 irrespective of the option to delay. It is worth pointing out that the trigger points π_i^{**} and π_i^* for $i = A, B$ are the same for all firms so there exist high-income firms that invest abroad at time 0 irrespective of the existence of an option to delay. To simplify further, we will assume that there are no tax effects on the sunk cost of an investment.

Tax competition in the absence of investment timing. In the absence of any option to delay, the home government maximizes the present value of tax revenues, net of profit shifting

$$\max_{\tau_A} \left[\frac{1+r}{r} H(\tau_A, \tau_B) \right],$$

where

$$\begin{aligned} H(\tau_A, \tau_B) \equiv & \left[\int_{\underline{\pi}}^{\bar{\pi}} \tau_A f(x) dx - \int_{\pi_B^*}^{\bar{\pi}} \beta_A^* f(x) dx \right] + \\ & + \int_{\pi_A^*}^{\bar{\pi}} \tau_A [q(1+u) + (1-q)(1-d)] f(x) dx + \int_{\pi_A^*}^{\bar{\pi}} \beta_B^* f(x) dx \end{aligned} \quad (11)$$

The first line is taxes paid by incumbent firms, while the second line is the additional revenue arising from investment in the home country by the foreign firm. Both terms are net of profit shifting. By invoking symmetry on the first order conditions of each country we obtain¹²

$$f(\tau) = a, \quad (12)$$

where $f(\tau) \equiv \frac{1-2\tau}{(1-\tau)^2}$ and $a \equiv \frac{(1+r)\bar{\pi}}{rI} < 1$. Solving (12) we state:

Proposition 2 *There exists an equilibrium tax rate $\tau^* = \frac{\sqrt{1-a}}{1+\sqrt{1-a}} < 1$.*

Given Assumption 1, it is also easy to ascertain that τ^* is unaffected by uncertainty. In fact, any type of news is insulated from having an effect on firms or the government, since the firm cannot postpone its investment. Thus,

Corollary 1 *The equilibrium tax rate τ^* is affected by $\underline{\pi}$ but independent of $\bar{\pi}$.*

This means that the tax rate in equilibrium is set so as to take into account that taxation may make it unprofitable for low-income firms to invest abroad, while FDI decisions made by high-income firms have no effect on the equilibrium tax rate, since these firms would invest irrespective of taxation.

¹²The full derivation is given in the Appendix.

Tax competition when firms can delay their investments Proposition 2 serves as a benchmark case in order to understand how the option to delay investments affects tax policy. When firms can delay their investment decisions the government's objective function must take into account investment timing. In particular, high-income firms (i.e. with $\pi \geq \pi_i^{**}$) will invest immediately. Low-income firms (i.e. with $\pi \leq \pi_i^{**}$) will wait instead. With respect to the 'now-or-never case', the government's tax revenues are also affected by profit shifting undertaken at time 1. For example, if low-income firms receive good news at time 1, they undertake the investment and start shifting profits to the low-tax country.

When firms can delay their investment, the home government's problem (country A) is

$$\max_{\tau_A} \left[\frac{1+r}{r} G(\tau_A, \tau_B) \right]$$

where

$$\begin{aligned} G(\tau_A, \tau_B) \equiv & \tau_A \left[\int_{\underline{\pi}}^{\bar{\pi}} f(x) dx - \int_{\pi_B^{**}}^{\bar{\pi}} \beta_A^* f(x) dx - \frac{q}{1+r} \int_{\tilde{\pi}_B}^{\pi_B^{**}} \beta_A^* f(x) dx \right] + \\ & + \int_{\pi_A^{**}}^{\bar{\pi}} \tau_A [q(1+u) + (1-q)(1-d)] f(x) dx + \int_{\pi_A^{**}}^{\bar{\pi}} \beta_B^* f(x) dx + \\ & + \frac{q}{1+r} \int_{\tilde{\pi}_A}^{\pi_A^{**}} [(1+u)\tau_A + \beta_B^*] f(x) dx, \end{aligned} \quad (13)$$

and $\tilde{\pi}_i \equiv \frac{1}{1+u} \frac{r}{1+r} \frac{I}{1-\tau_i}$ for $i = A, B$, measures the threshold level of profit above which investing at time 1 (in the good state) is profitable.

The first line in (13) is tax revenues collected from domestic firms, net of profit shifting. The second and third lines of $G(\tau_A, \tau_B)$ are tax revenues, net of profit shifting, due to the decision of foreign firms (resident in country B) to invest in the home country (A). Recall from (9) that bad news affects the trigger point π_B^{**} . From the definition of $G(\tau_A, \tau_B)$ we see that this has an affect on the amount of profits shifted by foreign high-income firms (second row in $G(\tau_A, \tau_B)$). The third row in $G(\tau_A, \tau_B)$ measures the expected profit-shifting opportunities exploited by foreign low-income firms (who may enter at time 1). Therefore, the probability of receiving good news by foreign low-income firms affects the expected present value of profits shifted, and, consequently the equilibrium tax rates.

Using symmetry assumptions on the full set of first order conditions we have that

$$g(\tau) \equiv \frac{b - 2c\tau}{(1-\tau)^2} = a, \quad (14)$$

where

$$b \equiv \frac{r + 1 - \frac{(1-u)^2}{1+u}q}{r + (1-q)(1-d)} > c \equiv \frac{r + 1 - \frac{1+u^2}{1+u}q}{r + (1-q)(1-d)}, \quad \text{and } \frac{b}{2} < c.$$

Hence, from (14) it follows that,

Proposition 3 *There exists a unique equilibrium tax rate τ^{**} such that*

$$\tau^{**} > \tau^*.$$

Proof See the Appendix.

Proposition 3 states that the Nash equilibrium tax rate is higher when firms can delay their investments as opposed to when they cannot delay. Put differently, the ability to postpone investments allows countries to set a higher tax rate in equilibrium. Proposition 3 can be understood by realizing that, *coeteris paribus*, an option to delay increases the threshold level for profits above which investments are profitable. As a consequence, the number of firms investing immediately falls as does the amount of tax revenues raised at time 0. On the other hand, low-income firms (which delayed their decision) have the opportunity to undertake investment after the realization of uncertainty. At time 1, therefore, the number of firms operating abroad rises. Moreover, late-comers face relatively high profits (i.e. $(1+u)\pi$). For these reasons, tax revenues grow in the second period. It is worth noting that late-comers decide whether to invest or not in a deterministic context making them less sensitive to taxation. Thus, since firms that invest at time 1 no longer face bad news, they can afford a higher tax rate. This explains the higher equilibrium tax rate.

An immediate consequence of Proposition 3 is that *only* low-income firms have an effect on tax policy:

Corollary 2 *The equilibrium tax rate τ^{**} is affected by $\underline{\pi}$, but independent of $\bar{\pi}$.*

As in the case when the firm could not delay its investment (Corollary 1), the tax rate is set so as to take into account that low-income firms are very tax sensitive while high-income firms are not (and thus not relevant when setting τ^{**}).¹³

It is instructive to compare the level of tax revenue when the firm can time its investment to the case when it cannot postpone its investment. Using Propositions 2 and 3, we may state:

¹³Note that equation (14) shows that the equilibrium tax rate τ^{**} is affected by the probability and the seriousness of both types of news. However, the effects are different.

Proposition 4 *Welfare in the tax competition equilibrium is higher when firms can delay their investments provided $\bar{\pi}$ is high enough.*

Proof See the Appendix.

Proposition 4 claims that $G(\tau^{**}, \tau^{**}) > H(\tau^*, \tau^*)$ for a sufficiently high value of $\bar{\pi}$. An increase in $\bar{\pi}$ reduces the percentage of firms with initial profits ranging in the interval (π^*, π^{**}) thereby increasing the average profitability of firms. When the average profitability rises, more firms will invest abroad at time 1 in the now-or-later case than in the now-or-never case, and this increases the tax base and tax revenue in all countries relative to the now-or-never case.

5 Conclusion

This paper has applied the Bad News Principle to derive how the ability to postpone foreign direct investments affects firms' behavior and tax policy. According to the BNP, the intertemporal investment decision depends on the seriousness of the bad news and its probability, and is independent of the good news. Following the BNP, we have shown that taxation affects the timing of investments and this result is in line with empirical findings (e.g. Devereux and Griffith 1998). In particular, we have shown that the effect of profit shifting on investment decisions depends on the firm's opportunity to delay investment. If profit shifting is easy to undertake, the firm requires a relatively higher expected pay-off before it invests abroad in the now-or-later case than in the now-or-never case.

A second set of results derives from tax competition. We have shown that the Nash equilibrium tax rates depend on the MNEs' ability to postpone investment. In particular, we have shown that taxes, tax revenue and welfare rise if the average profitability of firms in the economy is sufficiently high.

A final comment on our results pertains to Proposition 4. One of the main insights from the tax competition literature is that taxes are set too low in the tax equilibrium due to the positive fiscal externality that arises when one country increases its tax rate. With identical countries (as here) a tax increase by country i increases the tax base in all countries $j \neq i$. Since country i does not take this effect into account, taxes are set too low in the Nash equilibrium. Our model is by construction driven by the same positive externality and thus entails too low taxes in

equilibrium relative to a closed economy setting. The conjecture is that the severity of tax competition is lessened relative to the closed economy setting if firms can delay their investment choices. Although we do not model this explicitly, we leave it for future research.

6 Appendix

Derivation of eq (7)

If the firm does not invest abroad, the present value of its payoff is

$$\sum_{t=0}^{\infty} \frac{(1 - \tau_A) \pi_A}{(1 + r)^t} = \frac{1 + r}{r} (1 - \tau_A) \pi_A. \quad (15)$$

If it does invest abroad its overall net present value is

$$\begin{aligned} & [\Pi^N(0, \beta_A^*)] + q \left[\sum_{t=1}^{\infty} \frac{\Pi^N(u, \beta_A^*)}{(1+r)^t} \right] + \\ & + (1 - q) \left[\sum_{t=1}^{\infty} \frac{\Pi^N(-d, \beta_A^*)}{(1+r)^t} \right] - I, \end{aligned} \quad (16)$$

Using (15) and (16), the net present value of the firm's additional payoff is

$$\begin{aligned} NPV_{0,A} &= \Pi^N(0, \beta_A^*) + q \left[\sum_{t=1}^{\infty} \frac{\Pi^N(u, \beta_A^*)}{(1+r)^t} \right] + \\ &+ (1 - q) \left[\sum_{t=1}^{\infty} \frac{\Pi^N(-d, \beta_A^*)}{(1+r)^t} \right] - \frac{1+r}{r} (1 - \tau_A) \pi_A. \end{aligned} \quad (17)$$

Substituting (17) into equation (3), setting $NPV_{0,A} = 0$, and solving for π_B we obtain (7)

Derivation of equation (9)

The firm's overall net present value when investing at time 1 is

$$(1 - \tau_A) \pi_A + q \sum_{t=1}^{\infty} \frac{\Pi^N(u, \beta_A^*)}{(1+r)^t} + (1 - q) \cdot \sum_{t=1}^{\infty} \frac{(1 - \tau_A) \pi_A}{(1+r)^t} - \frac{1}{1+r} I \quad (18)$$

From (18), the net present value of the firm's additional payoff investing at time 1 is

$$\begin{aligned} NPV_{1,A} &= \left\{ (1 - \tau_A) \pi_A + q \sum_{t=1}^{\infty} \frac{\Pi^N(u, \beta_A^*)}{(1+r)^t} + \right. \\ &+ (1 - q) \cdot \sum_{t=1}^{\infty} \frac{(1 - \tau_A) \pi_A}{(1+r)^t} - \frac{1}{1+r} I \left. \right\} - \frac{1+r}{r} (1 - \tau_A) \pi_A. \end{aligned} \quad (19)$$

Substituting (17) and (19) into problem (4), setting $NPV_{0,A} - NPV_{1,A} = 0$, and solving for π_B one obtains the trigger value above which immediate FDI is profitable

Derivation of equation (12)

By Assumption 1; $q(1+u) + (1-q)(1-d) = 1$, and using this in (11) yields:

$$H(\tau_A, \tau_B) = \left[\tau_A - \frac{\bar{\pi} - \pi_B^*}{\bar{\pi} - \underline{\pi}} (\tau_A - \tau_B) \right] + \frac{\bar{\pi} - \pi_A^*}{\bar{\pi} - \underline{\pi}} \tau_B. \quad (20)$$

The first order condition of (20) is

$$\left(1 - \frac{\bar{\pi} - \pi_B^*}{\bar{\pi} - \underline{\pi}} \right) + \frac{\tau_A - \tau_B}{\bar{\pi} - \underline{\pi}} \frac{\partial \pi_B^*}{\partial \tau_A} - \frac{\tau_B}{\bar{\pi} - \underline{\pi}} \frac{\partial \pi_A^*}{\partial \tau_A} = 0. \quad (21)$$

Let us next focus on a symmetric equilibrium. Namely, we have $\tau_A = \tau_B = \tau$,

$\gamma_A = \gamma_B = \gamma$, $\pi_A^* = \pi_B^* = \pi^*(\tau) = \frac{r}{1+r} \frac{I}{1-\tau}$, $\pi_A = \pi_B = \pi$, and $\frac{\partial \pi_A^*}{\partial \tau_A} = \frac{\partial \pi_B^*}{\partial \tau_B} = \frac{\partial \pi^*(\tau)}{\partial \tau} = \frac{r}{1+r} \frac{I}{(1-\tau)^2} = \frac{\pi^*(\tau)}{1-\tau}$. Note that $\frac{\partial^2 H(\tau_A, \tau_B)}{\partial \tau_A^2} < 0$. This entails that there exists a maximum. It is now easy to see that eq. (21) reduces to (12)

Derivation of (14)

Using Assumption 1, the welfare function (13) can be rewritten as

$$G(\tau_A, \tau_B) = \left[\tau_A - \frac{\bar{\pi} - \pi_B^{**}}{\bar{\pi} - \underline{\pi}} (\tau_A - \tau_B) - \frac{q}{1+r} \frac{\pi_B^{**} - \bar{\pi}_B}{\bar{\pi} - \underline{\pi}} (\tau_A - \tau_B) \right] + \frac{\bar{\pi} - \pi_A^{**}}{\bar{\pi} - \underline{\pi}} \tau_B + \frac{q}{1+r} \frac{\pi_A^{**} - \bar{\pi}_A}{\bar{\pi} - \underline{\pi}} (u\tau_A + \tau_B). \quad (22)$$

The f.o.c. is

$$\begin{aligned} \frac{\partial G(\tau_A, \tau_B)}{\partial \tau_A} = 1 - \frac{\bar{\pi} - \left[\frac{r+(1-q)}{1+r} + \frac{q}{1+r} \frac{1}{1+u} \frac{1}{\eta} \right] \pi_B^{**}}{\bar{\pi} - \underline{\pi}} + \left[\frac{r+(1-q)}{1+r} + \frac{q}{1+r} \frac{1}{1+u} \frac{1}{\eta} \right] \frac{\tau_A - \tau_B}{\bar{\pi} - \underline{\pi}} \frac{\partial \pi_B^{**}}{\partial \tau_A} + \\ - \frac{\tau_B}{\bar{\pi} - \underline{\pi}} \frac{\partial \pi_A^{**}}{\partial \tau_A} + \frac{q}{1+r} \left(1 - \frac{1}{1+u} \frac{1}{\eta} \right) \frac{u\pi_A^{**} + (u\tau_A + \tau_B) \frac{\partial \pi_A^{**}}{\partial \tau_A}}{\bar{\pi} - \underline{\pi}} = 0. \end{aligned} \quad (23)$$

Under symmetry ($\pi_A^{**} = \pi_B^{**} = \pi^{**}(\tau) = \eta\pi^*(\tau)$), eq. (23) reduces to (14).

Proof Proposition 3

Recall (12) and (14). It is straightforward to show that:

1. $g(\tau)$ and $f(\tau)$ are continuous functions in the $[0, 1)$ region;
2. $g(0) > f(0) = 1$;
3. $f'(\tau) = \frac{-2\tau}{(1-\tau)^3} \leq 0$ for $\tau \in [0, 1)$, and $f''(\tau) = \frac{-2(1+2\tau)}{(1-\tau)^4} < 0$;

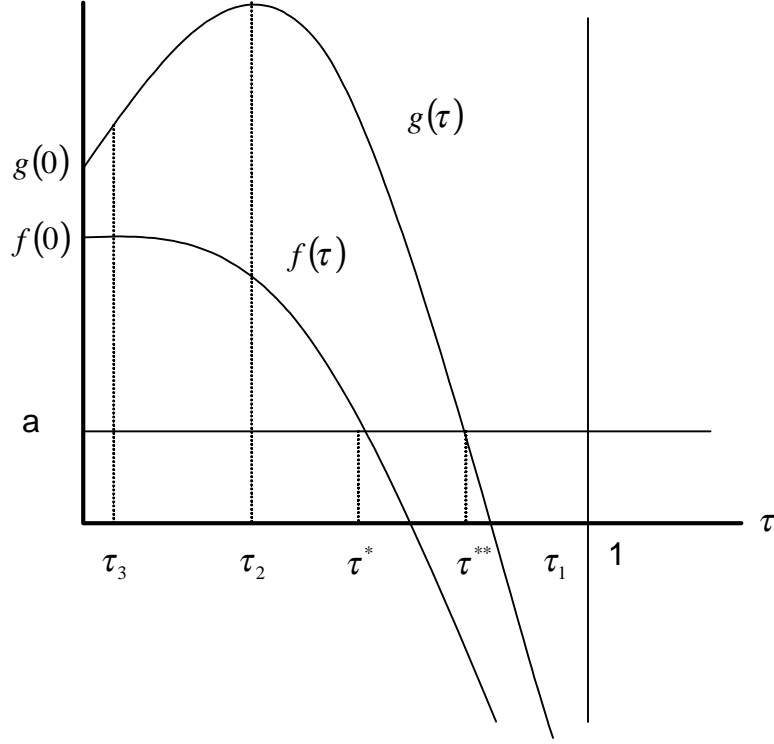


Figure 1: Proof of Proposition 3

4. $g(\tau) \propto (\tau_1 - \tau)$ with $\tau_1 \equiv \frac{b}{2c} > \frac{1}{2}$, $g'(\tau) \propto (\tau_2 - \tau)$ with $\tau_2 \equiv \frac{b-c}{c}$, $g''(\tau) \propto (\tau_3 - \tau)$, with $\tau_3 \equiv \frac{3b-4c}{c}$; it is easy to ascertain that $1 > \tau_1 > \tau_2 > \tau_3$;
5. $\lim_{\tau \rightarrow 1} g(\tau) = \lim_{\tau \rightarrow 1} f(\tau) = -\infty$;
6. $g(\tau) > f(\tau)$ for $\tau \in [0, 1)$.

The above conditions are illustrated in Figure 1. Given $f(\tau)$ there exists one point τ^{**} such that $g(\tau^{**}) = a$. The inequality $g(\tau) > f(\tau)$ for all $\tau \in [0, 1)$ is then sufficient to ensure that $\tau^{**} > \tau^*$. The Proposition is thus proven. ■

Proof Proposition 4

We substitute τ^* and τ^{**} into (11) and (22) and derive

$$H(\tau^*, \tau^*) = \frac{\tau^*}{\overline{\pi} - \underline{\pi}} (2\overline{\pi} - \underline{\pi} - \pi^*) \quad (24)$$

$$G(\tau^{**}, \tau^{**}) = \frac{\tau^{**}}{\overline{\pi} - \underline{\pi}} (2\overline{\pi} - \underline{\pi} - \pi^{**}) \quad (25)$$

Substituting (7) and (9) into (24) and (25), respectively, it follows that $G(\tau^{**}, \tau^{**}) > H(\tau^*, \tau^*)$ holds if

$$h(\bar{\pi}) > \frac{1}{(1 - \tau^*)(1 - \tau^{**})}, \quad (26)$$

where $h(\bar{\pi}) \equiv 2\frac{(1+r)\bar{\pi}}{rI} - a > 1$ is an increasing function of $\bar{\pi}$. As shown by Corollaries 1 and 2, the equilibrium tax rates are independent of $\bar{\pi}$. If, therefore, $\bar{\pi}$ is high enough then inequality (26) holds. This proves the Proposition. ■

References

- [1] Bernanke B.S. (1983), Irreversibility, Uncertainty, and Cyclical Investment, *The Quarterly Journal of Economics*, pp. 85-103.
- [2] Devereux, M.P. and R. Griffith (1998), Taxes and the Location of Production: Evidence from a Panel of US Multinationals, *Journal of Public Economics* 68, pp.335-367.
- [3] Dixit A. and Pindyck R.S. (1994), *Investment under Uncertainty*, Princeton University Press.
- [4] Dunning J. (1977), Trade, Location of Economic Activity and MNE: A Search for an Eclectic Approach, in B. Ohlin, P.O. Hesselborn and P.M. Wijkman (eds), *The International Allocation of Economic Activity*, Macmillan, London.
- [5] Gresik T. (2001), The Taxing Task of Taxing Transnationals, *Journal of Economic Literature*, 39, pp.800-838.
- [6] Haufler A. and G. Schjelderup (2000), Corporate Tax Systems and Cross Country Profit Shifting, *Oxford Economic Papers* 52, pp. 306-325
- [7] Hines J.R. (1999), Lessons from Behavioral Responses to International Taxation, *National Tax Journal*, 52, pp.304-322.
- [8] McDonald R. and D. Siegel (1986), The Value of Waiting to Invest, *Quarterly Journal of Economics*, 101, pp. 707-728.
- [9] Panteghini P.M. (2002), Endogenous Timing and the Taxation of Discrete Investment Choices, CESifo Working Paper No. 723.

- [10] Trigeorgis L. (1996), *Real Options, Managerial Flexibility and Strategy in Resource Allocation*, The MIT Press.
- [11] Wilson J.D. (1986), A Theory of Interregional Tax Competition, *Journal of Urban Economics* 19, pp.296-315.
- [12] Wilson J.D. (1999), Theories of Tax Competition, *National Tax Journal*, 52, pp. 269-304.
- [13] Wildasin D.E. and J.D. Wilson (2001), Capital Tax Competition: Bane or Boon?, Mimeo.
- [14] Zodrow G and P. Mieszkowski (1986), Pigou, Tiebout, Property Taxation and the Underprovision of Local Public Goods, *Journal of Urban Economics*, 19, pp.356-370.

CESifo Working Paper Series

(for full list see www.cesifo.de)

- 863 Edward Castronova, Theory of the Avatar, February 2003
- 864 Robert S. Chirinko, Hans van Ees, Harry Garretsen, and Elmer Sterken, Investor Protections and Concentrated Ownership: Assessing Corporate Control Mechanisms in the Netherlands, February 2003
- 865 Bernard M.S. van Praag and Pedro Cardoso, The Mix Between Pay-as-you-go and Funded Pensions and what Demography has to do with it, February 2003
- 866 Ernst Fehr, Urs Fischbacher, Bernhard von Rosenblatt, Jürgen Schupp, and Gert G. Wagner, A Nation-Wide Laboratory. Examining Trust and Trustworthiness by Integrating Behavioral Experiments into Representative Survey, February 2003
- 867 Frank Heinemann, The Inflationary Impact of Wage Indexation, February 2003
- 868 Eytan Sheshinski, Bounded Rationality and Socially Optimal Limits on Choice in a Self-Selection Model, February 2003
- 869 M. Hashem Pesaran, Estimation and Inference in Large Heterogenous Panels with Cross Section Dependence, February 2003
- 870 Luis H. R. Alvarez and Erkki Koskela, On the Tree-Cutting Problem under Interest Rate and Forest Value Uncertainty, February 2003
- 871 Norbert Berthold and Rainer Fehn, Unemployment in Germany: Reasons and Remedies, February 2003
- 872 Clemens Fuest, Bernd Huber, and Philipp Tilleßen, Tax Policy and Entrepreneurship in the Presence of Asymmetric Information in Capital Markets, February 2003
- 873 Eytan Sheshinski, Optimum and Risk-Class Pricing of Annuities, February 2003
- 874 Willi Leibfritz, Paul O'Brien and Jean-Christophe Dumont, Effects of Immigration on Labour Markets and Government Budgets – An Overview, February 2003
- 875 M. Hashem Pesaran and Allan Timmermann, How Costly is it to Ignore Breaks when Forecasting the Direction of a Time Series?, February 2003
- 876 Thorvaldur Gylfason and Gylfi Zoega, Education, Social Equality and Economic Growth: A View of the Landscape, February 2003
- 877 Robin Boadway and Jean-François Tremblay, Public Economics and Startup Entrepreneurs, February 2003

- 878 Erkki Koskela and Roope Uusitalo, The Un-Intended Convergence: How the Finnish Unemployment Reached the European Level, February 2003
- 879 Robert Fenge and Volker Meier, Pensions and Fertility Incentives, February 2003
- 880 Eytan Sheshinski, Note on Income Taxation and Occupational Choice, February 2003
- 881 A B Atkinson, Income Inequality in OECD Countries: Data and Explanations, February 2003
- 882 Thomas Gehrig and Rune Stenbacka, Venture Cycles: Theory and Evidence, February 2003
- 883 Ralf Becker and Thomas Hellmann, The Genesis of Venture Capital - Lessons from the German Experience, March 2003
- 884 Eytan Sheshinski, Note on the Optimum Pricing of Annuities, March 2003
- 885 Paul De Grauwe and Magdalena Polan, Globalisation and Social Spending, March 2003
- 886 F. van der Ploeg, Do Social Policies Harm Employment and Growth?, March 2003
- 887 Mirjam van Praag, Initial Capital Constraints Hinder Entrepreneurial Venture Performance: An empirical analysis, March 2003
- 888 Bernard Steunenberg, Coordinating Sectoral Policymaking: Searching for Countervailing Mechanisms in the EU Legislative Process, March 2003
- 889 Eytan Sheshinski, Optimum Delayed Retirement Credit, March 2003
- 890 Frederick van der Ploeg, Rolling Back the Public Sector – Differential effects on employment, investment and growth, March 2003
- 891 Paul De Grauwe and Marc-Alexandre SÉNÉgas, Monetary Policy in EMU when the Transmission is Asymmetric and Uncertain, March 2003
- 892 Steffen Huck and Kai A. Konrad, Strategic Trade Policy and the Home Bias in Firm Ownership Structure, March 2003
- 893 Harry Flam, Turkey and the EU: Politics and Economics of Accession, March 2003
- 894 Mathias Hoffmann and Ronald MacDonald, A Re-examination of the Link between Real Exchange Rates and Real Interest Rate Differentials, March 2003
- 895 Badi H. Baltagi, Espen Bratberg, and Tor Helge Holmås, A Panel Data Study of Physicians' Labor Supply: The Case of Norway, March 2003
- 896 Dennis C. Mueller, Rights and Citizenship in the European Union, March 2003
- 897 Jeremy Edwards, Gains from Trade in Tax Revenue and the Efficiency Case for Trade Taxes, March 2003

- 898 Rainer Fehn and Thomas Fuchs, Capital Market Institutions and Venture Capital: Do They Affect Unemployment and Labour Demand?, March 2003
- 899 Ronald MacDonald and Cezary Wójcik, Catching Up: The Role of Demand, Supply and Regulated Price Effects on the Real Exchange Rates of Four Accession Countries, March 2003
- 900 R. Selten, M. Schreckenberg, T. Pitz, T. Chmura, and S. Kube, Experiments and Simulations on Day-to-Day Route Choice-Behaviour, April 2003
- 901 Stergios Skaperdas, Restraining the Genuine *Homo Economicus*: Why the Economy Cannot be Divorced from its Governance, April 2003
- 902 Yin-Wong Cheung, Menzie D. Chinn, and Antonio Garcia Pascual, What Do We Know about Recent Exchange Rate Models? In-Sample Fit and Out-of-Sample Performance Evaluated, April 2003
- 903 Mika Widgrén, Enlargements and the Principles of Designing EU – Decision-Making Procedures, April 2003
- 904 Phornchanok Cumperayot, Dusting off the Perception of Risk and Returns in FOREX Markets, April 2003
- 905 Kai A Konrad, Inverse Campaigning, April 2003
- 906 Lars P. Feld and Stefan Voigt, Economic Growth and Judicial Independence: Cross Country Evidence Using a New Set of Indicators, April 2003
- 907 Giuseppe Bertola and Pietro Garibaldi, The Structure and History of Italian Unemployment, April 2003
- 908 Robert A.J. Dur and Otto H. Swank, Producing and Manipulating Information, April 2003
- 909 Christian Gollier, Collective Risk-Taking Decisions with Heterogeneous Beliefs, April 2003
- 910 Alexander F Wagner, Mathias Dufour, and Friedrich Schneider, Satisfaction not Guaranteed – Institutions and Satisfaction with Democracy in Western Europe, April 2003
- 911 Ngo Van Long, Raymond Riezman, and Antoine Soubeyran, Trade, Wage Gaps, and Specific Human Capital Accumulation, April 2003
- 912 Andrea Goldstein, Privatization in Italy 1993-2002: Goals, Institutions, Outcomes, and Outstanding Issues, April 2003
- 913 Rajshri Jayaraman and Mandar Oak, The Signaling Role of Municipal Currencies in Local Development, April 2003

- 914 Volker Grossmann, Managerial Job Assignment and Imperfect Competition in Asymmetric Equilibrium, April 2003
- 915 Christian Gollier and Richard Zeckhauser, Collective Investment Decision Making with Heterogeneous Time Preferences, April 2003
- 916 Thomas Moutos and William Scarth, Some Macroeconomic Consequences of Basic Income and Employment Subsidies, April 2003
- 917 Jan C. van Ours, Has the Dutch Miracle Come to an End?, April 2003
- 918 Bertil Holmlund, The Rise and Fall of Swedish Unemployment, April 2003
- 919 Bernd Huber and Marco Runkel, Optimal Design of Intergovernmental Grants under Asymmetric Information, April 2003
- 920 Klaus Wälde, Endogenous Business Cycles and Growth, April 2003
- 921 Ramon Castillo and Stergios Skaperdas, All in the Family or Public? Law and Appropriative Costs as Determinants of Ownership Structure, April 2003
- 922 Peter Fredriksson and Bertil Holmlund, Improving Incentives in Unemployment Insurance: A Review of Recent Research, April 2003
- 923 Bernard M.S. van Praag and Adam S. Booij, Risk Aversion and the Subjective Time Discount Rate: A Joint Approach, April 2003
- 924 Yin-Wong Cheung, Dissecting the PPP Puzzle: The Unconventional Roles of Nominal Exchange Rate and Price Adjustment, April 2003
- 925 Ugo Trivellato and Anna Giraldo, Assessing the 'Choosiness' of Job Seekers. An Exploratory Approach and Evidence for Italy, April 2003
- 926 Rudi Dornbusch and Stanley Fischer, International Financial Crises, April 2003
- 927 David-Jan Jansen and Jakob de Haan, Statements of ECB Officials and their Effect on the Level and Volatility of the Euro-Dollar Exchange Rate, April 2003
- 928 Mario Jametti and Thomas von Ungern-Sternberg, Assessing the Efficiency of an Insurance Provider – A Measurement Error Approach, April 2003
- 929 Paolo M. Panteghini and Guttorm Schjelderup, Competing for Foreign Direct Investments: A Real Options Approach, April 2003